Quantification of liver volume, liver fat fraction and subcutaneous-visceral fat changes with 3T MRI after hypocaloric diet in morbidly obese patients

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Introduction: Overweight and obesity are the most common nutritional disorders in the US. 34% of the adult population is estimated to have overweight (Body mass index: BMI 25-29.9), and 27% is obese (BMI ≥ 30) (1-2). Obesity is significantly associated with diabetes, insulin resistance, and nonalcoholic fatty liver disease (NAFLD). Given the overall prevalence of obesity in the US an estimated 30.1 million obese adults may have NAFLD (3). The NIH guidelines support surgical therapy as an option for well-informed and motivated patients who are morbidly obese.
The purpose of our study is to investigate the impact of a short period of hypocaloric diet on liver volume (LV), liver fat fraction (LFF) and subcutaneous-visceral fat measured with 3T MRI in morbidly obese patients before laparoscopic adjustable gastric banding (LAGB).

Methods: 10 morbidly obese patients (mean baseline weight and BMI, 148.1 ± 17.0 kg and 47.7 ± 5.1) were prospectively enrolled on a 2 week hypocaloric diet before LAGB. 3T MRI was obtained at baseline and at the end of the diet, using 3D GRE T1 for liver volume (LV) calculation, opposed-phased imaging (TR/TE/FA 180/2.45 in-phase, 6.2 out-of-phase/80°, 208 x 256, slice thickness 8 mm) for liver fat fraction (LFF) calculation (LFF-OPI), breath-hold single voxel 1H MR spectroscopy (MRS) (TR/TE 3000/30, 4 NEX, 8 cm3 voxel, located in the right liver lobe) also for LFF calculation (LFF-MRS), and a water excitation sequence (TR/TE 239/2.3/1 cm slice thickness, at the level of L2) for subcutaneous and mesenteric fat surface calculation. Operative biopsy was available immediately after the second MRI in 7 patients.

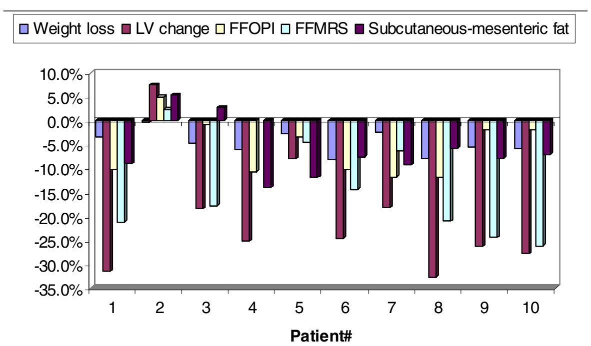
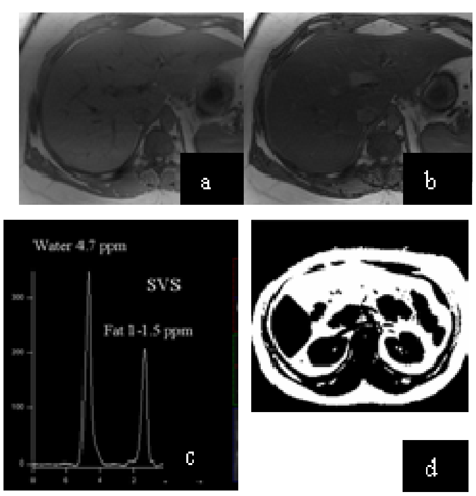


Fig. 1: Changes in clinical and MR parameters in 10 patients after diet.

Results (Table-Fig. 1): All patients but one (#2) experienced weight loss after the diet. Changes in weight, BMI, LV, LFF-OPI, LFF-MRS and subcutaneous-mesenteric fat surfaces are shown in the Table and Fig. 1. There was a significant correlation between weight loss and LV change (r 0.77, p < 0.01), and between LV and LFF-OPI changes (r 0.67, p < 0.0.04). There was no correlation between weight loss and LFF-MRS and subcutaneous-mesenteric fat changes. FF-MRS was better correlated with histologic FF than FF-OPI (FF-MRS: r 0.81, p < 0.05; FF-OPI: r 0.39, p=0.38). An example is shown in Fig. 2.

	Mean	Range
Weight loss (kg)	6.9	0.45-12.3
BMI loss	2.2	0.17-3.9
LV decrease (cm3)	688.8	-455-1475.1
LFF-OPI decrease (%)	5.7	-5.0-11.7
LFF-MRS decrease (%)	7.0	-0.7-23.8
Subcut.-mesenteric fat decrease (%)	6.3	-5.3-13.9



Discussion: These preliminary results demonstrate that MRI can document rapid changes in LV, LFF and subcutaneous-visceral fat after a short period of hypocaloric diet in morbidly obese patients.

Fig. 2: Morbidly obese patient with liver steatosis: a) In-phase, b) out-of-phase, c) MRS and d) segmented water excitation images. There is a signal drop on the out-of-phase image and an increased fat peak at MRS.

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